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Author: Ms. Christine Fanchiang
Colorado Center for Astrodynamics Research, University of Colorado, United States,
cfanchiang@gmail.com

USING A CREW PERFORMANCE CENTERED APPROACH FOR DESIGNING AND EVALUATING
HUMAN SPACECRAFT**Abstract**

Spaceflight presents a unique and challenging environment for both the designer and the human occupants. Due to the extreme and inhospitable surroundings the spacecraft becomes the only oasis for human life. The spacecraft must provide everything from the pressurized environment with atmospheric and thermal control to food provisions and hygiene needs with everything else in between. Besides just staying alive, the human occupants also play a vital role in adding robustness, redundancy, and functionality while reducing complexity and development time of the system. Therefore, it is crucial to ensure the spacecraft has been designed to both adequately accommodate the physiological human needs and effectively utilize the human's unique capabilities.

One of the difficulties of spacecraft design is in understanding how it impacts crew performance. Part of the challenge stems from the non-standardized usage of the term "crew performance". Various disciplines use the term in different contexts that span sports physiology, to mental capabilities, to levels of motivation. With the wide variety of applications, it is challenging to build a comprehensive and integrative framework for understanding crew performance. This paper reviews the definition and usage of the phrase "crew performance" throughout various human spaceflight studies with the goal of integrating them into a broad definition. The work identifies three main categories of performance: physiological, cognitive, and psychological. Each of these categories have their own corresponding metrics that can be aggregated together into a comprehensive framework outlined in this work. Additionally, the relationship between the different performance categories are identified and an initial quantitative model is proposed.

Approaching spacecraft design from the viewpoint of crew performance provides a powerful method for assessing and quantifying the quality of the design. For long duration and far destination missions, the interaction between spacecraft and crew play a critical role in maintaining the well-being, productivity, and safety of the crew. The proposed model could provide a helpful guide for designers and managers to ensure appropriate accommodation of the human component into the spacecraft.